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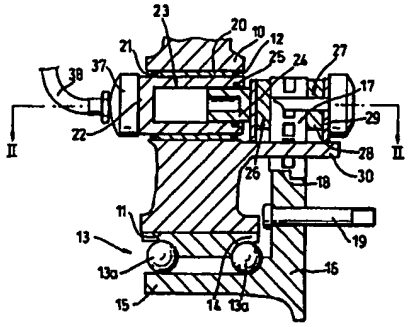
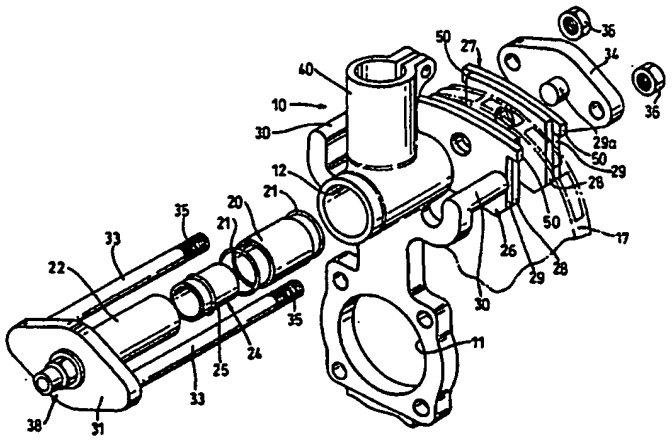
(54) Title: BRAKE ASSEMBLY FOR A ROAD VEHICLE

(57) Abstract

A brake assembly for a motor vehicle comprising a support element (10) having two apertures (11, 12), a brake disc (17) mounted for rotation adjacent to and at one side of the support element on a wheel bearing (13) mounted in one of the apertures, a double–acting, hydraulic piston and cylinder device (23) mounted for axial movement in a bearing (20) in the other aperture and two brake pads (26, 27) mounted one on each side of the brake disc, the arrangement being such that the piston (24) acts directly on one of the brake pads and the cylinder carries bridge means (30, 36) which spans the periphery of the brake disc and acts on the other brake disc, the forces tending to rotate the pads when the brake is applied being reacted directly on the support element. The support element may be a steerable knuckle forming part of a motor vehicle suspension.





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Brake Assembly for a Road Vehicle

Technical Field

This invention relates to disc brake assemblies for road vehicles. More particularly the invention relates to a brake and suspension assembly for a road vehicle.

Background Art

One conventional construction of disc brake for the front wheels of motor vehicles includes a bracket which is secured to the steering knuckle of the vehicle, the bracket carrying pins on which is mounted a caliper which straddles the brake disc and which contains one or more piston and cylinder assemblies. As hydraulic fluid is supplied to the cylinders, the brake pads on either side of the brake disc are forced into engagement with the brake disc by the pistons and the caliper slides on the pins on the bracket.

It has also been proposed, for example in US A 3 712 422, to have a disc brake assembly which includes an open-ended cylinder which contains two pistons. One of these pistons acts directly on the backing plate of one brake pad whereas the other piston acts through a yoke or caliper on the other brake pad. The cylinder includes ring seals which seal against the pistons. It is necessary in this construction to avoid the weight of the yoke or caliper being carried by the cylinder seals and the cylinder carries pins which slide in bores provided in the caliper. In this construction the rotational drag of one of the brake pads is reacted by shoulders on the cylinder while the drag of the other pad is reacted by shoulders on the caliper.

In addition GB-A-1 427 245 discloses a disc brake in which a double-acting piston and cylinder device is mounted in an aperture in a housing and arranged so that, upon actuation, the piston applies one pad directly to the disc and the other pad is applied by the cylinder acting through a yoke which straddles the brake disc. In this brake the rotational drag on the one pad is taken directly by the housing and the rotational drag on the other pad is transmitted to the housing through the cylinder. The housing is connected to the suspension of the vehicle. The transmission of the rotational drag of one of the pads to the housing through the cylinder will tend, in practice,

to jam the cylinder. Moreover the weight of the assembly will be considerable since the housing is separate from the vehicle suspension.

Disclosure of the Invention

It is an object of the present invention to provide a brake assembly which is lighter than those heretofore proposed and in which the drag forces on the brake pads are reacted completely separately from the clamping forces urging the pads into engagement with the disc.

According to the invention we provide a brake assembly for a road vehicle comprising: a support structure, a first aperture in the support structure, a wheel bearing having relatively rotatable inner and outer parts with one of the parts secured to the support structure so that the other part passes through the first aperture, a brake disc mounted on said other part of the wheel bearing in an axially fixed position adjacent to and at one side of the support structure, a double-acting, hydraulic piston and cylinder device having its cylinder mounted for axial movement on the support structure, bridge means spanning the periphery of the brake disc and integral with or secured to said cylinder, two brake pads mounted on the support structure, one on each side of the brake disc, complementary abutments on one of the brake pads and on the support structure which engage to react the forces tending to rotate said brake pad during braking; the arrangement being such that the piston of the piston and cylinder device operates directly on one of the brake pads and the cylinder operates on the other brake pad via the bridge means and so that upon admission of hydraulic fluid to the piston and cylinder device to increase the effective length thereof both brake pads are forced against the brake disc; characterised in that the support structure is a unitary support element and has a second aperture spaced from the first, in that said cylinder is mounted for axial movement in said second aperture, and in that there are complementary abutments on both brake pads and on the support element which engage to react the forces tending to rotate the brake pads during braking so that the forces tending to rotate each of the brake pads are wholly reacted by said abutments.

Brief Description of the Drawings

Four embodiments of the invention will now be described by way of example with reference to

the accompanying drawings in which:-

Figure 1 is a diagrammatic vertical section through part of the steering knuckle of a motor vehicle showing a brake assembly according to one embodiment of the invention; and

Figure 2 is a section on the Line II-II of Figure 1;

Figure 3 is another section similar to Figure 2 but showing the knuckle in more detail;

Figure 4 is an exploded perspective view of the assembly;

Figure 5 is a view similar to Figure 1 of a second embodiment of the invention;

Figure 6 is a section on the line VI-VI of Figure 5;

Figure 7 is a perspective view of a third embodiment of the invention;

Figure 8 is a view showing the knuckle of Figure 7 and the abutments for resisting the drag forces on the brake pads;

Figure 9 is a vertical cross-section through the embodiment of Figure 7;

Figure 10 is a perspective view of the double acting piston and cylinder device of the embodiment of Figure 7;

Figure 11 is a perspective view of part of the embodiment of Figure 7; and

Figure 12 is a perspective view of a fourth embodiment of the invention.

Best Mode for Carrying Out the Invention

Referring to Figures 1 to 4, a steering knuckle for a motor vehicle is indicated at 10. The steering

knuckle will be supported at its upper and lower ends 10a and 10b by parts of the vehicle suspension not shown. The knuckle has first and second apertures 11 and 12 which are formed as cylindrical through bores and are spaced apart.

Received in the first aperture 11 is a wheel bearing 13 having an outer part 14 which is an interference fit in the aperture 11 and an inner part 15 which is shown as integral with a hub 16, although the hub and inner race may be separate. Bearing balls 13a are arranged between the parts 14 and 15 in known manner and grease seals (not shown) will be provided. The hub 16 carries a brake disc 17 which fits to the hub 16 at a stepped interface 18. The hub carries studs 19 for a road wheel.

Mounted within the second aperture 12 is a plain bearing 20 which may, for example, be bronze or plastic and which is sealed at its ends with seals 21. The bearing 20 will preferably be a sealed-for-life bearing and may, for example, be made in two parts with a grease reservoir between the parts.

Slidably mounted in the bearing 20 is the cylinder 22 of a double-acting piston and cylinder device 23. A hollow piston 24 is received in the cylinder 22 and is sealed therein by a ring seal 25.

Mounted one on each side of the brake disc 17 are brake pads 26 and 27. Each brake pad consists of a friction lining and a backing plate shown at 28 and 29 respectively. Each backing plate is provided with ears, shown at 50 in Figure 4, which engage with tracks 30 on the knuckle to resist rotational forces when the brake is applied.

Secured to the left hand of the cylinder 22 in Figures 1, 2 and 4 is a first yoke 31 which is connected by rods 33 to a second yoke 34 which engages the backing plate 29 of the brake disc 27 and is centred by a dowel 29a on the backing plate 29 in Figure 2 and on the yoke 34 in Figure 4.

The rods 33 span the periphery of the brake disc but are not supported or guided although they may be engaged by anti-rattle springs, not shown. At their left hand ends in Figures 1 and 2 the rods 33 are threaded at 35 and carry nuts 36. The right hand ends of the rods are fixed in the yoke

31. This enables easy disassembly of the arrangement for servicing. The yoke 31 is formed with a passage 37 which communicates with a hydraulic connection 38 to the cylinder 22.

Figures 3 and 4 show the knuckle 10 in more detail. At its upper end 10a there is a collar 40 to receive the lower end of a McPherson strut forming part of a motor vehicle suspension. At its lower end 10b the knuckle has an arm 41 for connection to a lower vehicle suspension member. Figure 3 also shows the outer member 42 of a constant velocity joint connected to the hub. This outer member 42 would receive an inner member, cage and balls and the inner member would be connected by a driveshaft (not shown) to a vehicle gear box.

To apply the brake, hydraulic fluid is supplied through the connection 38 and passage 37 into the interior of the cylinder 22. There is thus relative movement between the cylinder 22 and the piston 24 so that the effective length of the piston and cylinder device increases. The piston 24 acts directly on the backing plate of the brake pad 26 whereas the cylinder 22 acts through the yoke 31, rods 33 and yoke 34 on the backing plate of the brake pad 27. The disc is thus pressed between the brake pads and the brake applied. During this operation the cylinder 22 slides in the bearing 20. On release of the hydraulic pressure the seal 25 is designed slightly to retract the piston 24.

In the foregoing construction the cylinder 22, being received in the bearing 20, is supported therein and the weight of the yokes 31 and 34 and the rods 33 are carried by the reaction between cylinder 22 and the bearing 20. The cylinder 22 can slide in the bearing 20 which as mentioned above is preferably a sealed-for-life bearing and this arrangement ensures that there is no unwanted stress on the seal 25.

The rotational drag forces on the brake pads are taken wholly by the tracks 30 on the knuckle which engage with the ears 50 on the brake pads. The means which provide the clamping forces on the pads are thus separate from the means which take the reaction of the rotational drag forces on the pads.

The invention has been described with reference to two yokes 31 and 34 which are connected by rods 33. However this assembly may be replaced by a flanged assembly made of sheet metal of

appropriate thickness or the rods may be replaced with profiled elements if they have to take any substantial force on braking. The closer the rods are the less the force will be.

The abutment members could be connected together at their ends remote from the knuckle if desired. In another arrangement the abutment members could be rods cantilevered from the knuckle and the backing plates of the brake pads could have holes through which the rods pass.

Figures 5 and 6 show a second embodiment in which similar parts to those shown in Figures 1 to 4 are designated by the same reference numeral with the prefix of "1".

The main difference between the embodiments is that in Figures 5 and 6 the interconnecting yokes 31 and 34 of Figures 1 to 4 are replaced by a caliper formed integrally with the cylinder of the double acting piston and cylinder device.

Integral with the cylinder 122 is a caliper 132 which extends from the right hand end of the cylinder and straddles the periphery of the brake disc 117. The caliper is L-shaped having a horizontal limb 133 and a vertical limb 134 which is on the side of the brake disc 117 away from the cylinder 122. The vertical limb 134 of the caliper has an aperture 135 to receive a dowel 136 on the backing plate 129 of the brake pad 127 thus to locate the brake pad relative to the caliper in a radial direction. In a similar manner the backing plate 129 of the brake pad 126 has a dowel 137 which fits into the hollow cylinder 124 to locate the brake pad in a radial direction. The dowels 136 and 137 are a loose fit in the caliper 132 and the piston 124 respectively in the circumferential direction but a close fit radially. Although the dowels 136 and 137 locate the brake pads radially they do not react any of the pad drag forces which are taken by the ears 130 on the backing plates 129 which engage with rods 131 mounted on the knuckle 110.

At their left hand ends, the rods 131 are secured in blocks 138 which are secured to the knuckle 110. At their right hand ends, the rods 131 are connected by a tie-bar 139 held in place by nuts 140 and shoulders on the rods 131.

The cylinder 122 is provided with a hydraulic connection 141 which communicates with a passage 142 in the closed end of the cylinder and extends to the interior thereof.

To apply the brake, hydraulic fluid is supplied through the connection 141 and passage 142 into the interior of the cylinder 122. There is thus relative movement between the cylinder 122 and the piston 124 so that the effective length of the piston and cylinder device increases. The piston 124 acts directly on the backing plate 129 of the brake pad 126 whereas the cylinder 122 acts through the caliper 132 on the backing plate 129 of the brake pad 127. The disc 117 is thus clamped between the brake pads and the brake applied. During this operation the cylinder 122 slides in the bearing 120. On release of the hydraulic pressure the seal 125 is designed slightly to retract the piston 124.

The clamping forces, therefore, are provided by the double-acting piston and cylinder device 123 and the caliper 132. As the brake pads are urged into engagement with the brake disc 117 the brake pads tend to rotate about the rotary axis of the brake disc. These rotational forces are reacted by the ears 130 engaging the rods 131 which are anchored in the knuckle 111. Thus the brake pad torque reaction for each brake pad is taken directly to the knuckle and it will be seen that the torque reaction structure, i.e. the ears 130, the rods 131 and the blocks 138 is entirely separate from the clamping structure of the double-acting cylinder 123 and the caliper 132 so that no torque load is carried by the clamping mechanism therefore it can act freely. The ears 130 could be apertured and the rods 131 could pass through the apertures. If desired the brake pad torque reaction could be taken by tracks formed directly on the knuckle as described in relation to Figures 1 to 4.

Referring now to Figures 7 to 11, these show a third embodiment of the invention. A steering knuckle for a motor vehicle is indicated at 50 and has means 51 and 52 at its upper and lower ends whereby it can be connected to the suspension of a motor vehicle. The knuckle has a steering arm 53 at its upper end connectable to the steering mechanism of the vehicle.

As shown in Figure 8, the knuckle has first and second apertures 54 and 55, the aperture 55 being above the aperture 54. As shown in Figure 9, the outer race 56 of a wheel bearing is received in the aperture 54 and rotatable therein is the inner race 57 which has a flange 58. As described above the inner race of the wheel bearing may be connected to the outer member of a fixed constant velocity joint (not shown), the inner member of which is connected to the vehicle driveshaft.

A brake disc 59 is secured to the flange 58. The brake disc, as it is seen from Figure 9, has a top hat section with its inner flange 60 secured to the flange 58.

Mounted in the aperture 55 is a double-acting piston-cylinder device 61 comprising a cylinder 62 and sliding therein a piston 63. As shown in Figure 9 there is a seal 64 between the piston and cylinder. Formed integrally with the cylinder 61 is a caliper 65 which has an axially extending portion 66 and a radially inwardly extending portion 67 which, as shown in Figure 10, is forked, there being a central aperture 68.

As most clearly seen in Figure 8, a U-shaped abutment member 70 is secured to ears 71 on the knuckle 50 by bolts 71a. The abutment member has two limbs 72 each of which is provided with an inclined abutment surface 74 and a vertical abutment surface 75, see Figure 8. Formed on a part 73 of the knuckle are two pairs of inclined and vertical abutment surfaces 74a and 75a respectively, one pair of which is shown in Figure 8, and which are aligned with the abutment surfaces 74 and 75 on the member 70. The brake disc 59 is received in an opening 100 between the part 73 of the knuckle and the abutment member 70.

Mounted on each side of the brake disc is a brake pad. In Figures 9 and 11 the outer brake pad is shown at 76 and the inner brake pad at 77. Each brake pad 76 and 77 comprises a layer of friction material and a backing plate 78. Referring to Figure 11, each backing plate has ears 79 which engage with the vertical abutment surfaces 75 and 75a on the abutment member 70 and the part 73 of the knuckle and resist drag forces on the pads when the brake is applied. Each backing plate also has a pair of inclined edges 80 which engage with the inclined abutment surfaces 74 and 74a on the abutment member 70 and the knuckle part 73 to locate the brake pads. The brake pads are located as shown in Figure 11 in a lateral direction and vertically by the caliper 65 which has a central slot 81 shown in Figure 7 to receive ears 82 on the backing plates.

In operation, referring to Figure 9, hydraulic fluid is introduced into the space 83 between the piston and cylinder causing the effective length of the piston and cylinder device to increase. The piston 63 engages the brake pad 77 and applies it to the inside surface of the brake disc 59. The radially inwardly extending part 67 of the caliper 65 engages the brake pad 76 and pushes it against the brake disc 59.

The forces tending to rotate the brake pads during braking are reacted by the abutment surfaces 74, 74a and 75, 75a on the abutment member 70 and the knuckle part 73 and none of these forces are taken through the piston and cylinder device which only provides the clamping force.

Thus in this arrangement the clamping forces and the drag forces are reacted entirely separately and there is no risk that the operation of the piston and cylinder device will be adversely affected by absorbing the rotational drag loads as in the prior art referred to above.

Moreover, since the piston and cylinder device is mounted directly in the aperture 55 in the knuckle there is considerable saving of weight as compared with present constructions in which a caliper support bracket is secured to the suspension linkage of a vehicle.

The use of a U-shaped abutment member 70 to carry the abutments for one of the brake pads with the abutments for the other pad being formed directly on the knuckle makes maintenance a simple matter. The abutment 70 can be removed by releasing the bolts 71a and then drawing the caliper 65 to the left in Figure 9. The outer brake pad 76 can then be removed which then allows the brake disc 59 to be removed to give access to the inner brake pad 77 which can then be replaced.

Figure 12 shows a fourth embodiment of the invention which differs from that described with reference to Figures 7 to 11 only in the arrangement for operating the outside brake pad. Referring to Figure 12, the knuckle is indicated at 90 and the brake disc at 91. The piston of the double acting piston and cylinder arrangement is indicated at 92 and the cylinder carries a yoke 93 which is connected by bolts 94 to a U-shaped yoke 95 having limbs 96. The piston 92 engages the inner brake pad 97 and the yoke 95 engages the outer brake pad 98.

The abutment means for locating the brake pads are not shown but are as described in relation to Figure 11 and the operation of this embodiment is as described above for Figures 7 to 11.

Instead of being a steerable knuckle the knuckle could be the knuckle of an independent rear suspension. In either case the knuckle will be connected to the vehicle chassis by the suspension.

Claims

1. A brake assembly for a road vehicle comprising:-
a support structure,
a first aperture in the support structure,
a wheel bearing having relatively rotatable inner and outer parts with one of the parts secured to the support structure so that the other part passes through the first aperture,
a brake disc mounted on said other part of the wheel bearing in an axially fixed position adjacent to and at one side of the support structure,
a double-acting, hydraulic piston and cylinder device having its cylinder mounted for axial movement on the support structure,
bridge means spanning the periphery of the brake disc and integral with or secured to said cylinder,
two brake pads mounted on the support structure, one on each side of the brake disc,
complementary abutments on one of the brake pads and on the support structure which engage to react the forces tending to rotate said brake pad during braking; the arrangement being such that the piston of the piston and cylinder device operates directly on one of the brake pads and the cylinder operates on the other brake pad via the bridge means and so that upon admission of hydraulic fluid to the piston and cylinder device to increase the effective length thereof both brake pads are forced against the brake disc;
characterised in that the support structure is a unitary support element and has a second aperture spaced from the first, in that said cylinder is mounted for axial movement in said second aperture, in that there are complementary abutments on both brake pads and on the support element which engage to react the forces tending to rotate the brake pads during braking so that the forces tending to rotate each of the brake pads are wholly reacted by said abutments.

2. A brake assembly according to Claim 1 wherein each of the brake pads has a backing plate which provides said brake pad abutments which engage with support element abutments which are cantilevered from the support element.

3. A brake assembly according to Claim 2 wherein the support-element abutments for one

of the brake pads are integral with the support element and the support-element abutments for the other brake pad are releasably secured in position on the support element.

4. A brake assembly according to Claim 3 wherein the support-element abutments which are releasably secured in position on the support element are formed on a U-shaped member.

5. A brake assembly according to Claim 2 wherein the ends of the support element abutments remote from the support element are connected.

6. A brake assembly according to Claim 1 or Claim 2 wherein the backing plates have apertures in which the support element abutments are received.

7. A brake assembly according to any preceding claim wherein the bridge means comprises a caliper integral with or secured to said cylinder.

8. A brake assembly according to any preceding claim wherein the bridge means comprises two interconnected yokes, one of the yokes being connected to said cylinder.

9. An assembly according to any preceding claim wherein the support element is a suspension knuckle having upper and lower ends arranged for attachment to the suspension of a motor vehicle.

10. An assembly according to Claim 9 in which the knuckle is steerable.

11. An assembly according to any preceding claim wherein said other part of the wheel bearing is connected to one member of a universal joint the other member of which is connected to a drive shaft.

12. An assembly according to Claim 11 wherein the universal joint is a constant velocity joint.

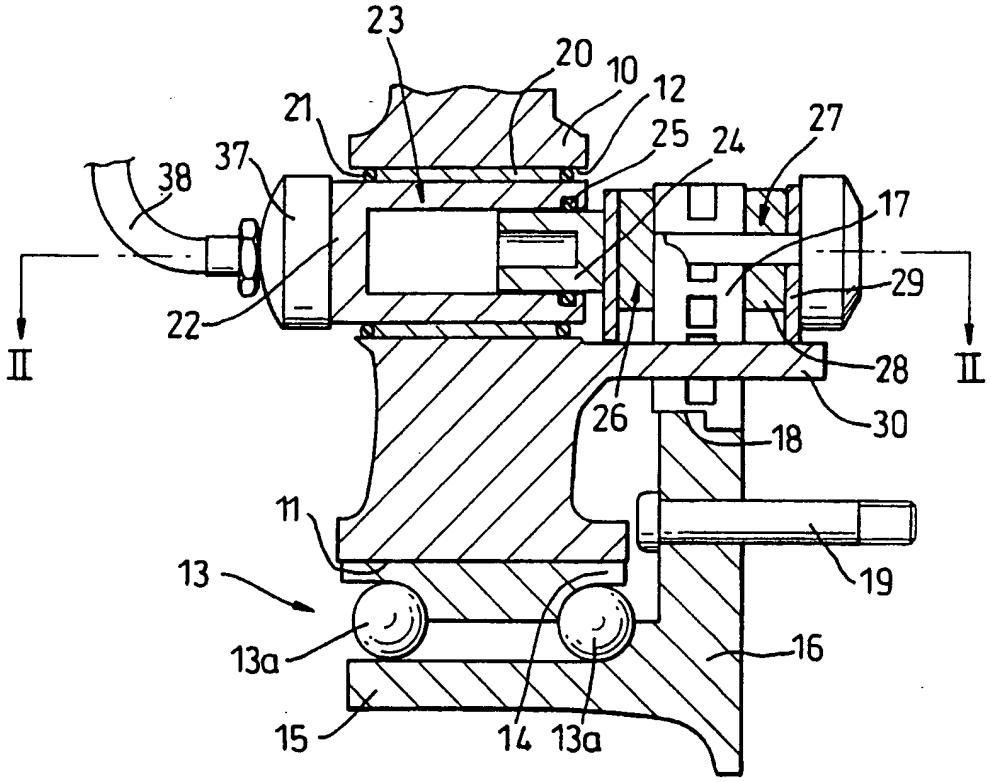
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Fig. 1

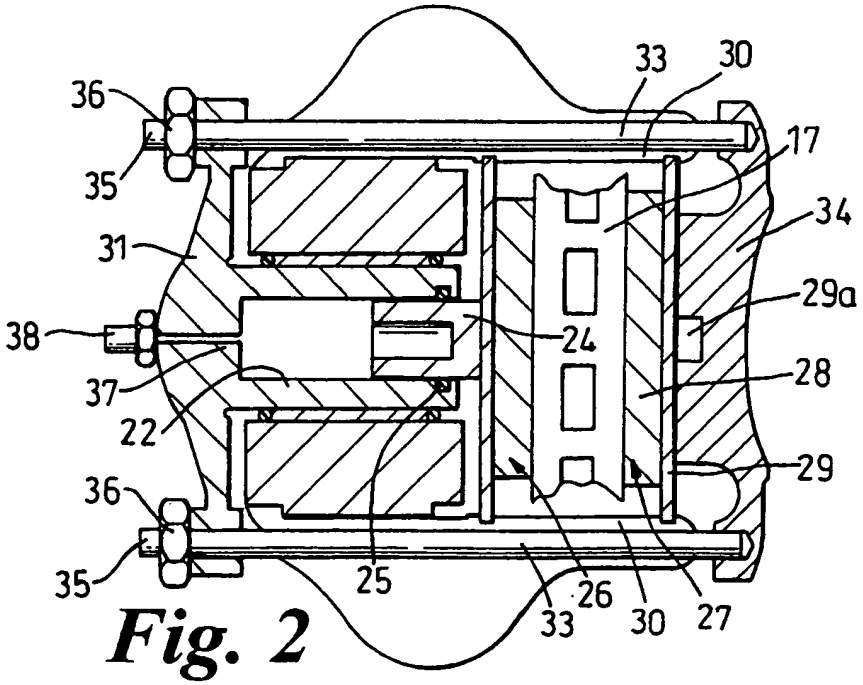
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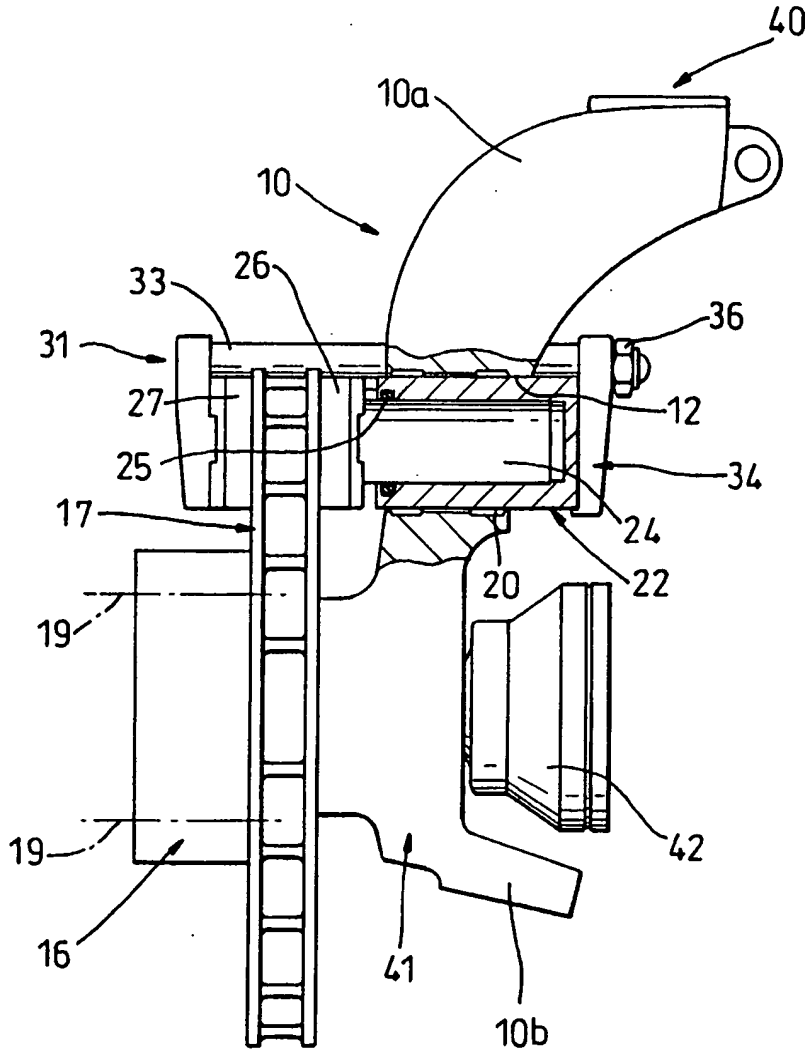
Fig. 2



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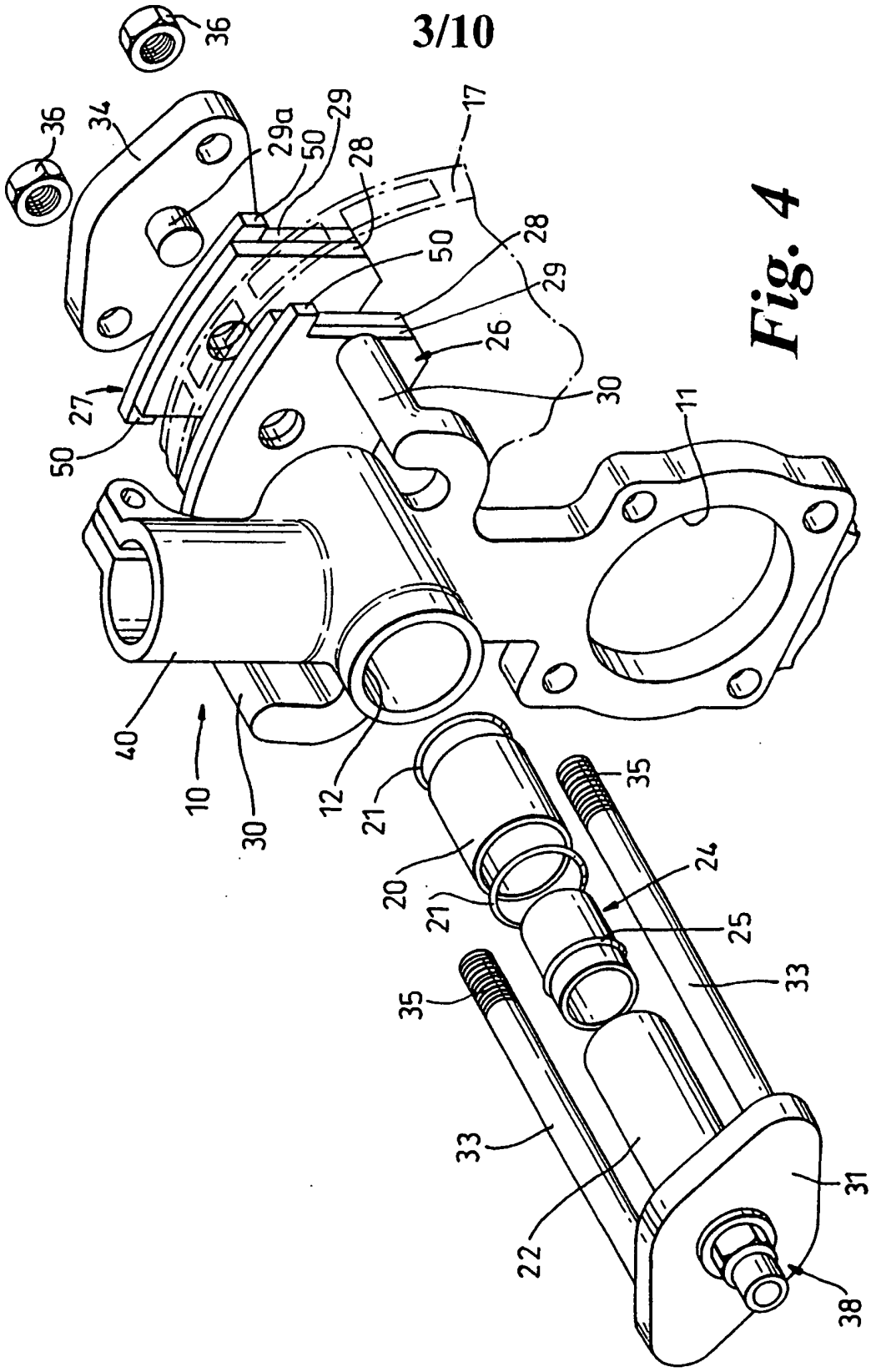
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Fig. 4

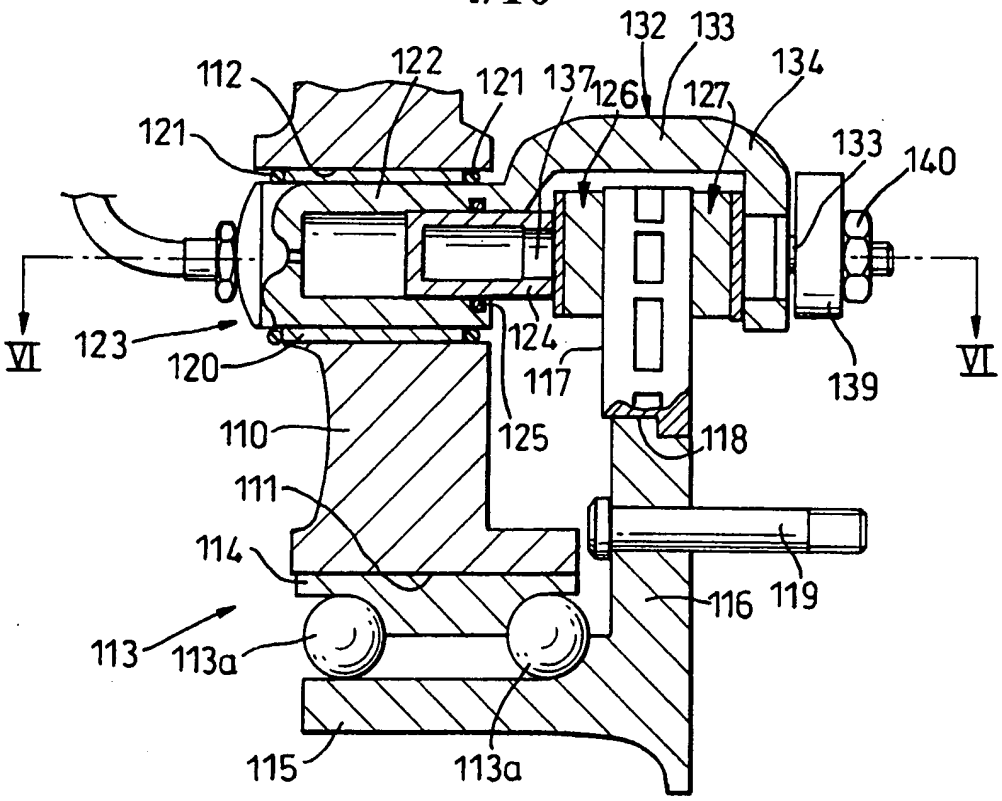
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Fig. 5

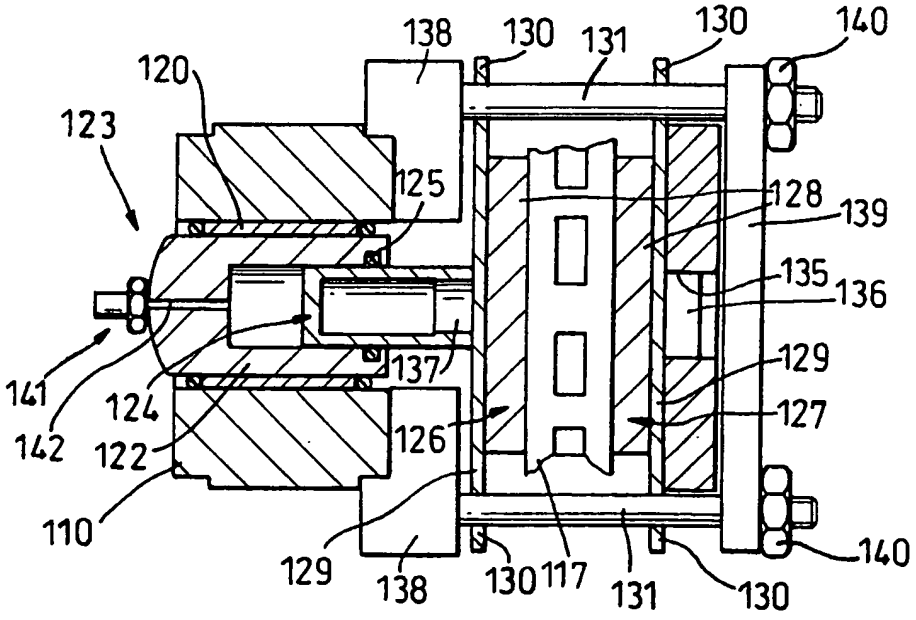
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Fig. 6

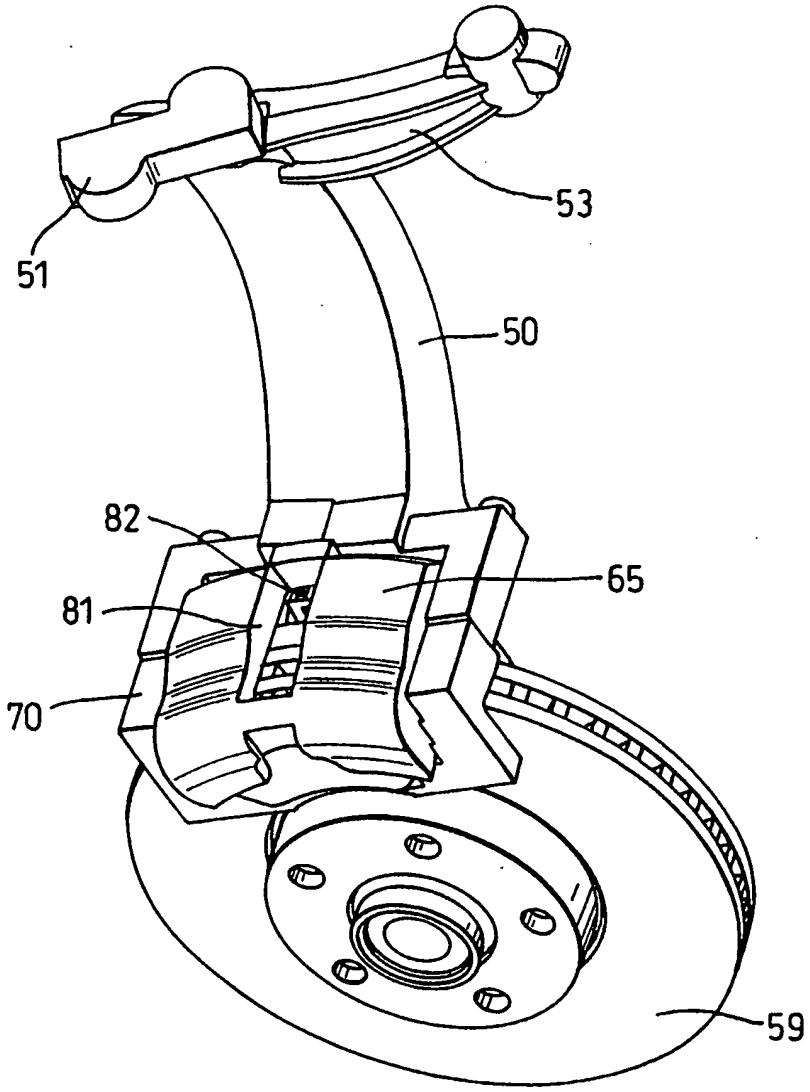

Fig. 7

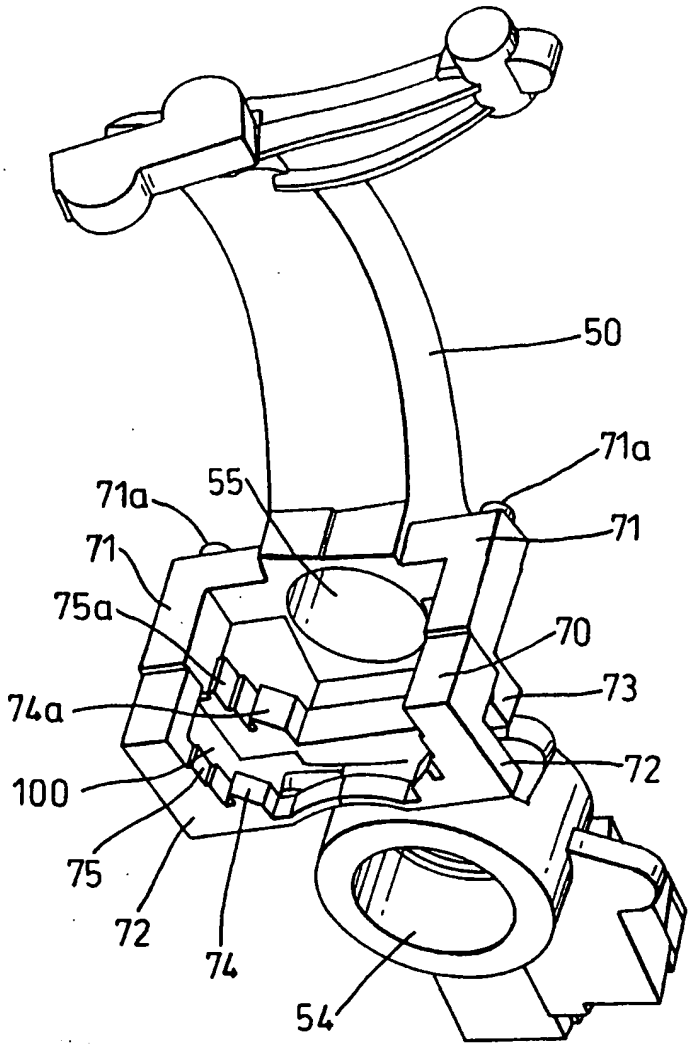

Fig. 8

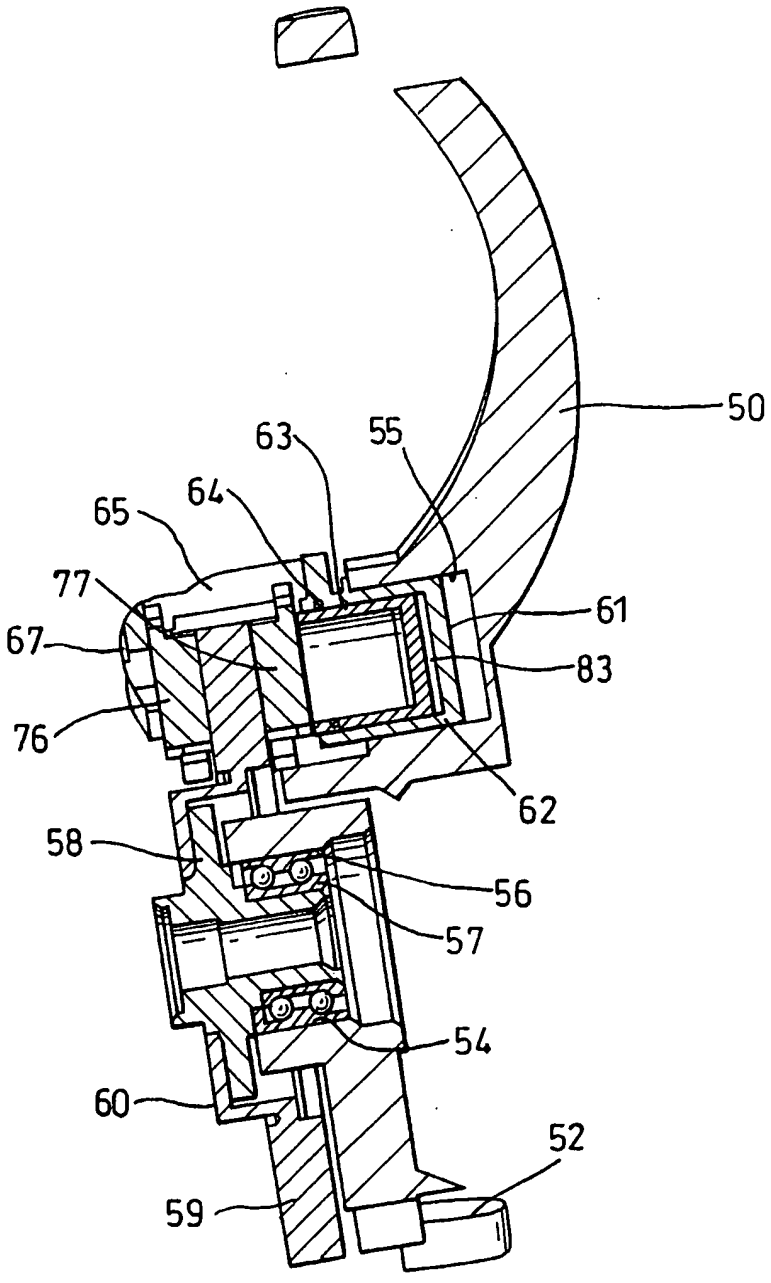

Fig. 9

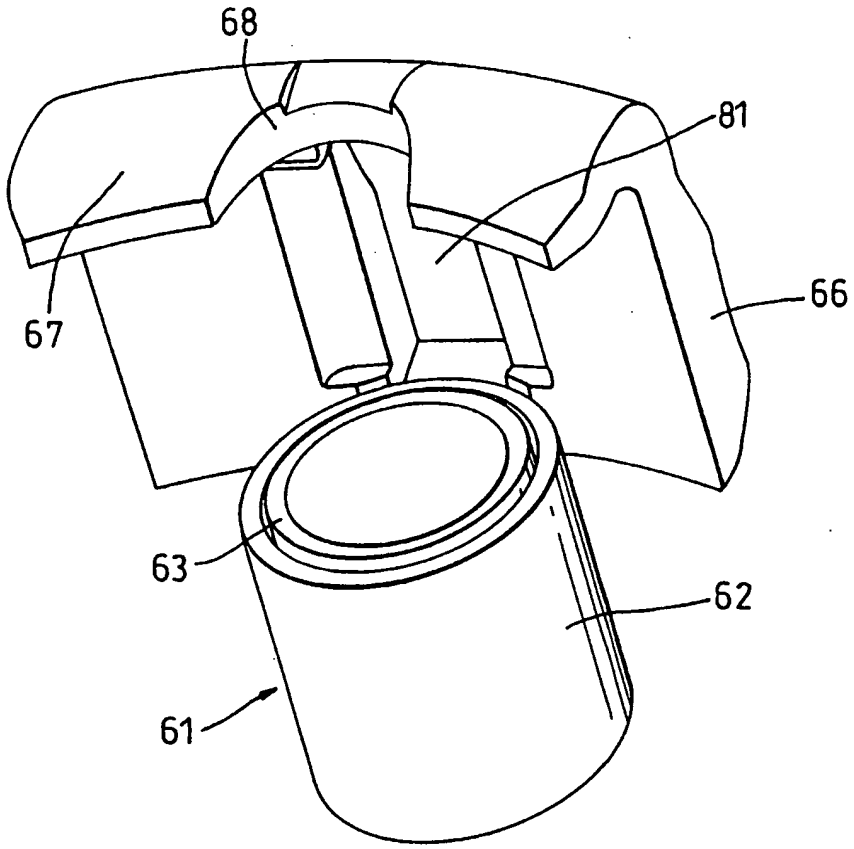

Fig. 10

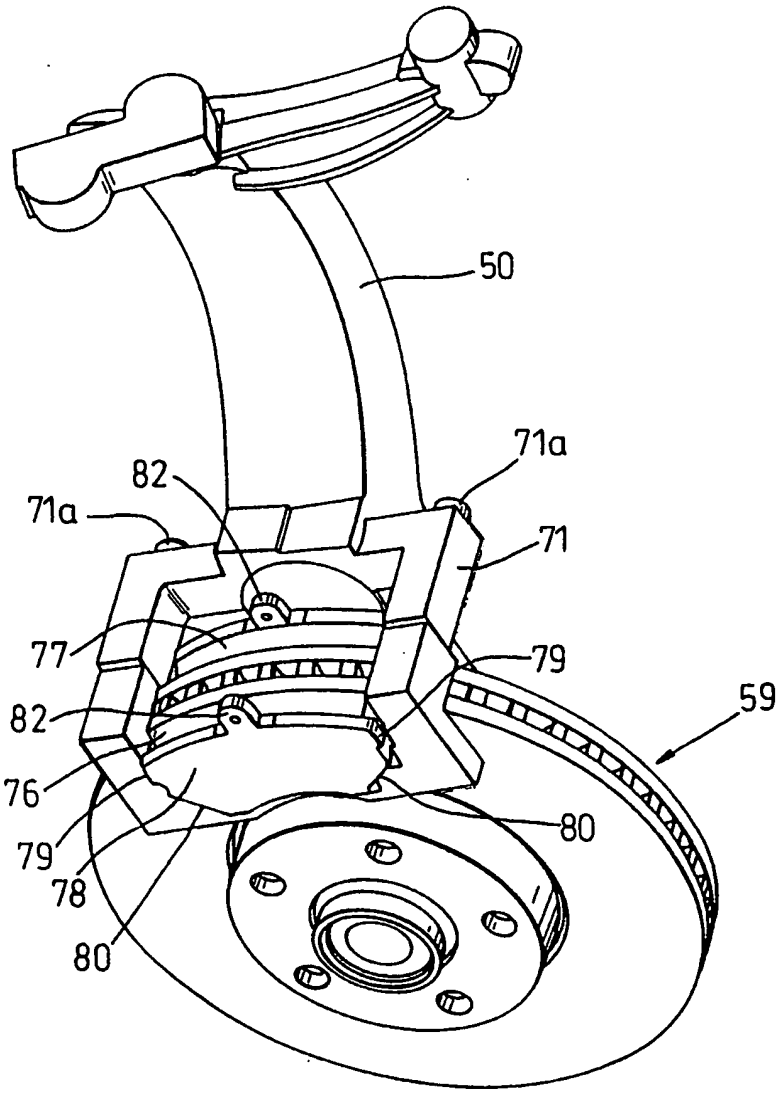

Fig. 11

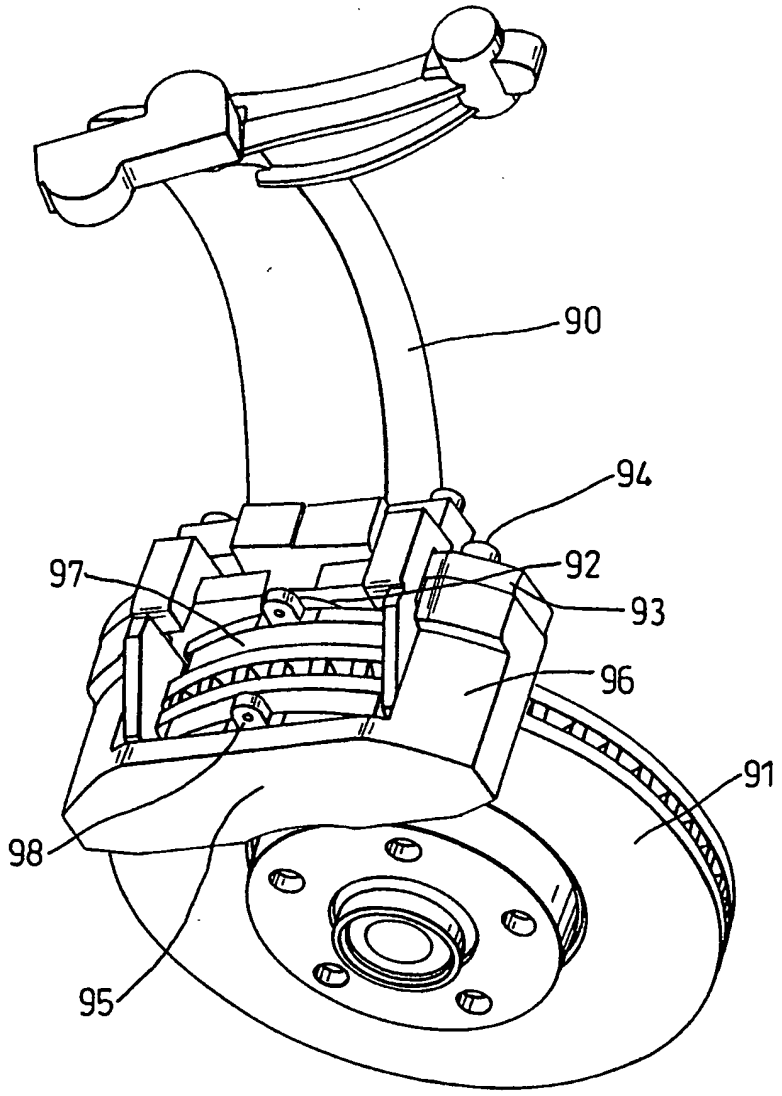

Fig. 12

INTERNATIONAL SEARCH REPORT

Inte onal Application No
PCT/GB 98/02680

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 F16D55/226

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 F16D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	FR 2 335 739 A (VOLKSWAGENWERK AG) 15 July 1977	1,2,6,7, 9-12
A	see the whole document	3
Y	FR 2 192 925 A (GEN MOTORS CORP) 15 February 1974 see figure 1	1,2,6,7, 9-12
A	FR 2 335 741 A (GIRLING LTD) 15 July 1977 see page 6, line 4 - line 29; figures	1-3,6
A	DE 43 14 311 A (TEVES GMBH ALFRED ;KUGELFISCHER G SCHAEFER & CO (DE)) 3 November 1994 see abstract; figures 1,3	1,2,9-12

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"A" document defining the general state of the art which is not considered to be of particular relevance

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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Date of the actual completion of the international search	Date of mailing of the international search report
11 December 1998	17/12/1998

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Gertig, I

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INTERNATIONAL SEARCH REPORT

Inte onal Application No
PCT/GB 98/02680

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	PATENT ABSTRACTS OF JAPAN vol. 004, no. 136 (M-033), 24 September 1980 & JP 55 090725 A (AKEBONO BRAKE IND CO LTD), 9 July 1980 see abstract	1,7
A	GB 1 427 245 A (GIRLING LTD) 10 March 1976 cited in the application see figure 1	1,7

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INTERNATIONAL SEARCH REPORT

Information on patent family members

Inte ional Application No
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